

REMARKS

Applicants have amended claims 15, 20, 25, 30 and 32 to recite that the reformer is arranged directly in the main exhaust gas stream (4) in full flow of the exhaust gas. Support for this amendment is found in paragraph [0012].

Claims 35-37 stand rejected under 35 U.S.C. §112, second paragraph for purportedly being indefinite. In particular the Examiner states “and/or by a combination of the two options” lacks antecedent basis. Applicants have amended claims 35-37 to recite:

“...comprising setting a quantity of fuel which is fed to the reforming unit via at least one of i) inside the engine, and ii) a secondary injection (5) into the exhaust gas stream upstream of the reforming unit.”

Support for the amendments is found, e.g., in paragraph [0013] of the application as published. As amended the claims clearly define the invention and Applicants request that the Examiner reconsider and withdraw the rejection of the claims under 35 U.S.C. §112, second paragraph.

Claims 15, 18, 25, 28, 30 and 32 stand rejected under 35 U.S.C. §103(a) for purportedly being unpatentable over Pfeifer et al. (US Patent No. 6,725,647) in view of Shiino et al. (US Patent No. 6,845,610). Applicants respectfully disagree.

The Office Action acknowledges that Pfeifer et al. does not disclose a reforming unit upstream of the NO_x storage catalyst to generate hydrogen, but points out that Shiino et al. discloses an exhaust gas purification method that teaches one to place a reformer in the exhaust line to produce hydrogen from the exhaust gas (Office Action page 4). The Office Action states that it would have been obvious to place the reformer of Shiino et al. upstream of the NO_x catalytic converter of Pfeifer et al. for the advantage of providing a demanded amount of reformed gas.

The reformer in Applicants' claimed apparatus, however, is arranged directly in a main exhaust gas stream, in the full flow of the of the exhaust section, of an internal combustion engine. In contrast, the reformer 20 in Shiino et al. is not arranged in the main exhaust line; rather it is located in a branch conduit 26, having an exhaust gas flow control valve 28 and connected to a fuel tank 22 and to a buffer tank having a structure to temporarily accumulate the reformed gas in a given volume and serves as reformed gas accumulation means. Fuel is delivered to the reformer via a fuel flow control valve 30. Shiino et al. teaches that it is very important to control the amount of fuel and exhaust gas that is introduced into the reformer such that the reformer is operated at maximum operating performance. (see e.g. Col. 2, lines 14-22; Col. 3, lines 47-53 and; Col 4, lines 22-26). Thus Shiino et al. actually teaches away from arranging the reformer in the main exhaust gas line in the full flow of the exhaust gas

because the exhaust would not be controlled and therefore would eliminate the advantages taught by Shiino et al.

Furthermore, Applicants' invention optimizes the installation space so as to effect a more compact design. By including the reformer of Shiino et al. on a conduit off the main exhaust gas line, with a buffer tank for storing the reformed gas, the optimization of the installation space and more compact design is lost. Thus, the combination of Pfeifer et al. and Shiino et al. does not teach or suggest an exhaust gas aftertreatment device in which the reforming unit is arranged directly in a main exhaust gas stream in full flow of the exhaust gas. Accordingly, the combination of Pfeifer et al. and Shiino et al. does not replicate or render Applicants' claimed invention obvious. Applicants therefore respectfully request that the Examiner reconsider and withdraw the rejection of the claims under 35 U.S.C. §103(a) in view of Pfeifer et al. and Shiino et al.

Claims 16, 17, 26 and 27 stand rejected under 35 U.S.C. §103(a) as unpatentable over Pfeifer et al. as applied to claims 15 and 25 above and further in view of Patchett (US Patent No. 6,125,629). Applicants respectfully disagree.

As the Office Action notes, Pfeifer et al. fails to disclose placing a reforming unit upstream of the NO_x storage catalyst to generate hydrogen, and fails to describe specifically an oxidation catalytic converter arranged downstream of the SCR catalytic converter. The Office Action indicates nevertheless that Patchett discloses an exhaust aftertreatment system that

teaches to place an oxidation catalyst downstream of that SCR catalyst and concludes that it would have been obvious to utilize the oxidation catalyst of Patchett in the system of Pfeifer et al. for the advantage of reduced emissions. However the proposed modification would render the Pfeifer et al. invention unsatisfactory for its intended purpose.

In the Pfeifer et al. exhaust gas treatment unit there is a first catalyst unit (I) that produces ammonia from the exhaust gas constituents of a rich exhaust gas composition, and a second catalyst unit (II) that is located downstream of the first catalyst unit and temporarily stores the ammonia produced by the first catalyst unit. In the second catalyst unit, NO_x present in the exhaust gas under lean exhaust conditions undergoes a reduction reaction using the temporarily stored ammonia as a reducing agent. The exhaust gas treatment unit may also contain a third catalyst unit (III) that oxidizes lean exhaust gases prior to their entering the second catalyst unit. The second catalyst (II) is an SCR catalyst (see col. 3, lines 51-63 and Col. 6, lines 17-41). Pfeifer et al. also discloses that the first catalyst is preferably a three way catalyst and is located just downstream of the engine to ensure that high temperatures generally above 400°C.

If one of skill in the art were to place the SCR catalyst (II) upstream of the first catalyst unit (I) it would be unsatisfactory for its intended purpose in that, in such a position the second catalyst unit (II) would not have access to the ammonia produced by the first converter and therefore would not temporarily

store the ammonia produced by the first catalyst unit to reduce the NOx present in the exhaust gas under lean exhaust conditions. Thus while one might be able to place an SCR catalyst upstream of the first catalyst, there would be no apparent reason to make the proposed modification to Pfeifer et al.'s arrangement, said doing so would not replicate the claimed invention.

Furthermore, as discussed above, Pfeifer et al. and Shiino et al. fail to suggest placing a reforming unit upstream of the NOx storage catalyst in the main gas exhaust stream in full flow of the exhaust section. Patchett also fails to teach a reforming unit arranged upstream of the NOx storage catalyst in the main gas exhaust stream in full flow of the exhaust section.

The foregoing remarks demonstrate that Pfeifer et al. in combination with Patchett fails to teach or suggest the claimed invention. Applicants request that the Examiner reconsider and withdraw the rejection of the claims under 35 U.S.C. §103(a) in view of Pfeifer et al. over Patchett.

Claims 19, 29 and 31 stand rejected under 35 U.S.C. §103(a) over Pfeifer et al. in view of Stroia et al. (US Publ. No. 2004/0006975). Applicants respectfully disagree.

The Office Action states that Stroia discloses an exhaust after treatment system that teaches a particulate filter that acts as a reformer to produce hydrogen. From this premise, it concludes that it would have been obvious to

one having ordinary skill in the art at the time the invention was made to utilize the particulate filter of Stroia as the reformer of Pfeifer et al. for the advantage of particulate emissions control. However, Pfeifer et al. does not teach the use of a reformer; it also does not address a diesel engine or suggest the need for particulate control. Even if Pfeifer et al. did disclose a desire to control particulate matter, there is no reason for Pfeifer et al. to use a reformer in combination with the filter. In addition, the “reformer” that is said to be disclosed in the Stroia Abstract is a soot catalyst filter and is to be used in conjunction with NO_x adsorbers arranged in parallel. (Thus, the soot catalyst filters are not in the main exhaust gas line in full flow of the exhaust gas).

In addition, Stroia teaches away from the use of an SRC catalyst unit, which is a part of Applicants' claimed invention and the apparatus disclosed in Pfeifer et al. Stroia states that, “Although a promising technology, SCR catalyst systems require an additional reducing agent (aqueous urea) that must be stored in a separate tank, which opens issues of effective temperature range of storage (to eliminate freezing) as well as distribution systems that must be constructed for practical use of this technology” paragraph [0005]. Thus, Stroia guides one of skill in the art away from the use of an SCR catalyst.

The foregoing remarks demonstrate that Stroia in combination with Pfeifer et al. fails to render the invention as claimed obvious and Applicants respectfully request that the Examiner reconsider and withdraw the rejection of the claims under 35 U.S.C. §103(a) over Pfeifer et al. in view of Stroia.

Claims 33 and 34 stand rejected under 35 U.S.C. §103(a) for purportedly being unpatentable over Pfeifer et al. as applied to claim 32 above, and further in view of Patterson (US Patent No. 6,732,506). However, as discussed above, Pfeifer et al. fails to disclose an after treatment system comprising a reformer, wherein the reformer is arranged in the main exhaust gas line in full flow of the exhaust gas. Patterson's disclosure of a wide band lambda sensor is insufficient to compensate for Pfeifer et al.'s deficiencies. Patterson, like Pfeifer et al., fails to teach or suggest a reformer, and thus the combination of Pfeifer et al. and Patterson fails to teach or suggest Applicants' invention as claimed and as such fails to render the invention obvious.

In view of the foregoing remarks, Applicants respectfully request that the Examiner reconsider and withdraw the rejection of the claims under 35 U.S.C. §103(a) over Pfeifer et al. in view of Patterson.

Claims 20-24 stand rejected under 35 U.S.C. §103(a) for purportedly being unpatentable over Pfeifer et al. as applied to claims 15-19 above and further in view of Gandhi et al. (US Publ. No. 2004/0076565). Applicants respectfully disagree.

As discussed above, Pfeifer et al. alone or in combination with the cited art fails to teach or suggest an after treatment system with a reformer arranged in the main exhaust gas line in full flow of the exhaust gas. Gandhi et al. also fails to teach or suggest a reformer arranged in the main exhaust gas line in full flow

of the exhaust gas and as such Gandhi et al. in combination with Pfeifer et al. fails to teach or suggest the invention as claimed.

Further, the Office Action states that the lone difference being the orientation of the SCR catalyst with respect to the NO_x storage catalytic converter, and that Gandhi teaches that the location of an SCR catalyst is interchangeable with respect to the NO_x trap (Gandhi Figs 7A and 7B). (Office Action page 8) However, applicants respectfully disagree with this description of Figures 7a and 7b. Figures 7a-7c show three proposed washcoat configurations incorporating the lean NO_x trap and NH₃--SCR formulations into the same substrate. FIGS. 7a and 7b display the first and second proposed configurations having the lean NO_x trap and NH₃--SCR washcoat formulations on the bottom and top layer, respectively, of a single component. Gandhi proposes that the top layer could be a highly porous structure that allows better and faster contact between the chemicals and gas phase and the active sites in the second layer. Thus Gandhi et al. does not teach that the location of the SCR catalyst and the NO_x catalytic units of Pfeifer et al. are interchangeable. Rather Gandhi et al. proposes only that different arrangements of layers be provided within a single component (see paragraph [0052]) without any supporting data to demonstrate, and one of skill in the art would be unable to predict, whether the arrangements are equivalent. Thus the combination of Pfeifer et al. and Gandhi fails to render the invention as claimed obvious and Applicants request that the Examiner

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reconsider and withdraw the rejection of the claims under 35 U.S.C. §103(a) over Pfeifer et al. in view of Gandhi et al.

If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #095309.56876US).

Respectfully submitted,

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